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Well here we are. After all this time, we are at the final three chapters of Earth's After School Rest. I took a little more time than usual translating these chapters since they all run together in a sort of "to be continued..." sort of manner, and I decided to release them all within a short time from one another because I really couldn't stand that idea of letting all the readers of this manga wait between them as usual since there is so much information packed into these last three chapters. Get ready for info dumping because here is comes! Also, lots of translation notes regarding physics this time around.

I hope you enjoy the last three chapters!

地球の放課後

吉富昭仁

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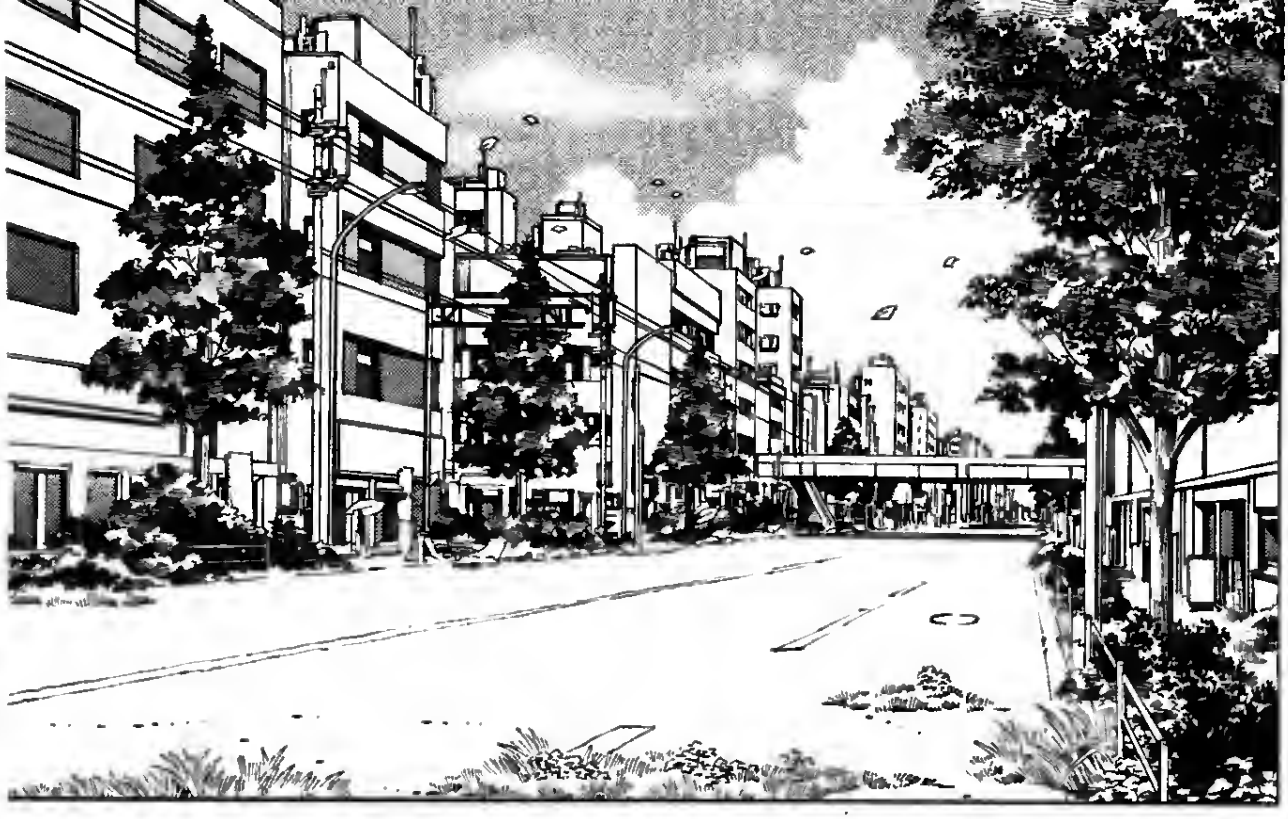
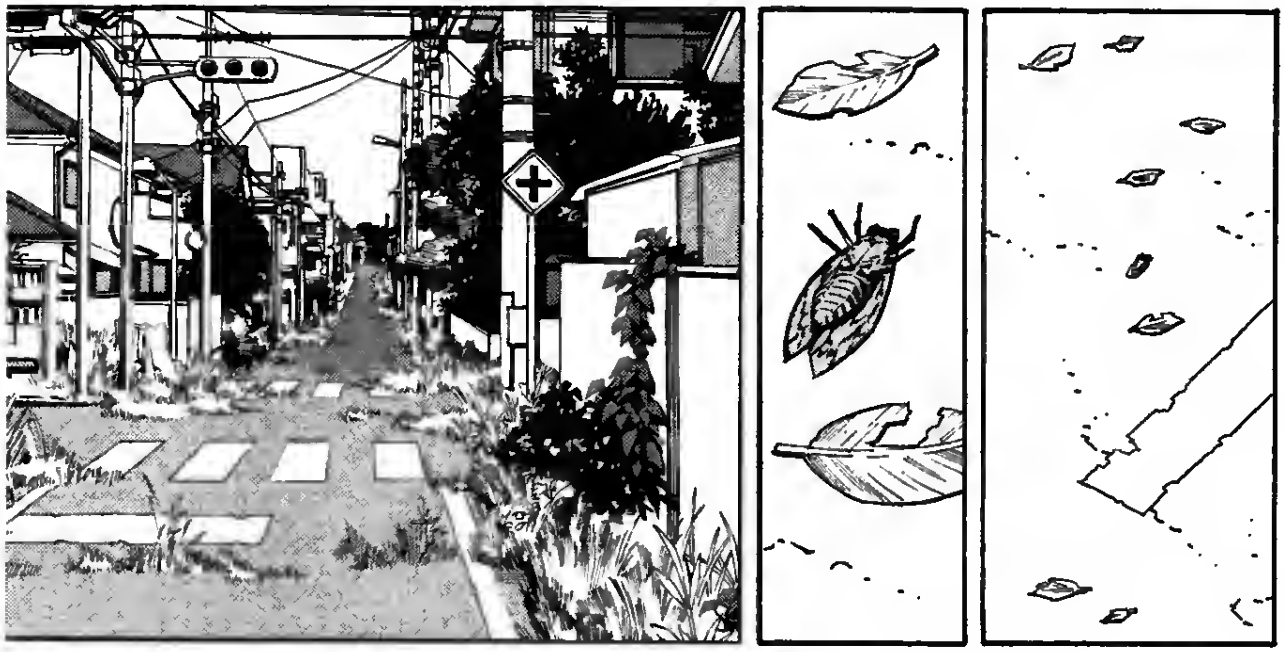
I7 SCANS

Champion RED Comics
RED

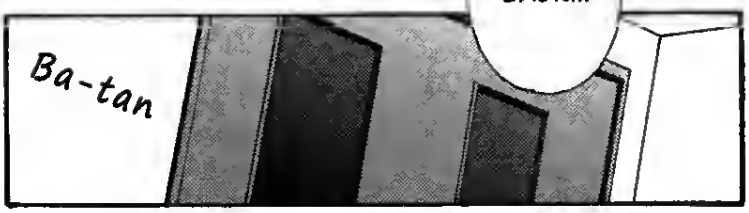


SFX: ZA ZA - DESOLATE WIND BLOWING RATTLING LEAVES

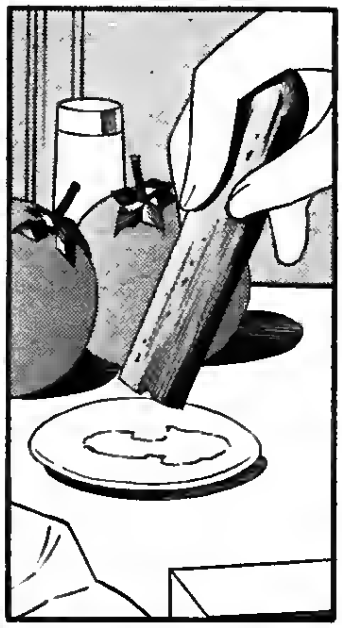


AFTER33/Alone on Earth

SFX: BUCHA - SNAP



SFX: BA-TAN - DOOR CLOSING



SFX: KARI - CRUNCH; PORI - MUNCH

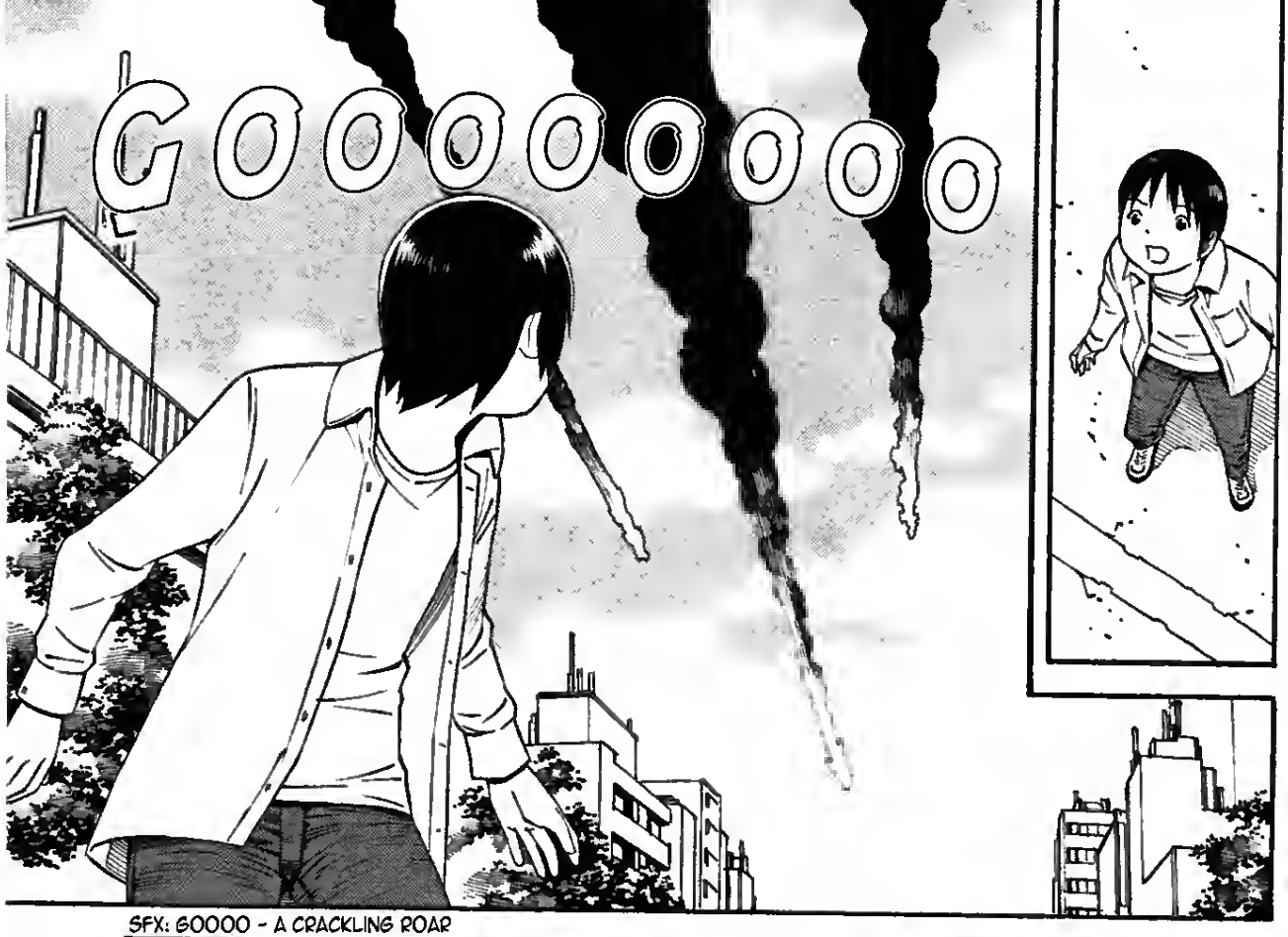
SFX: PYUUUUU - HOWLING WIND

SFX: GATA GATA - CREAKING OF THE HOUSE DUE TO WIND
CHIRIRIN - WIND CHIME RINGING

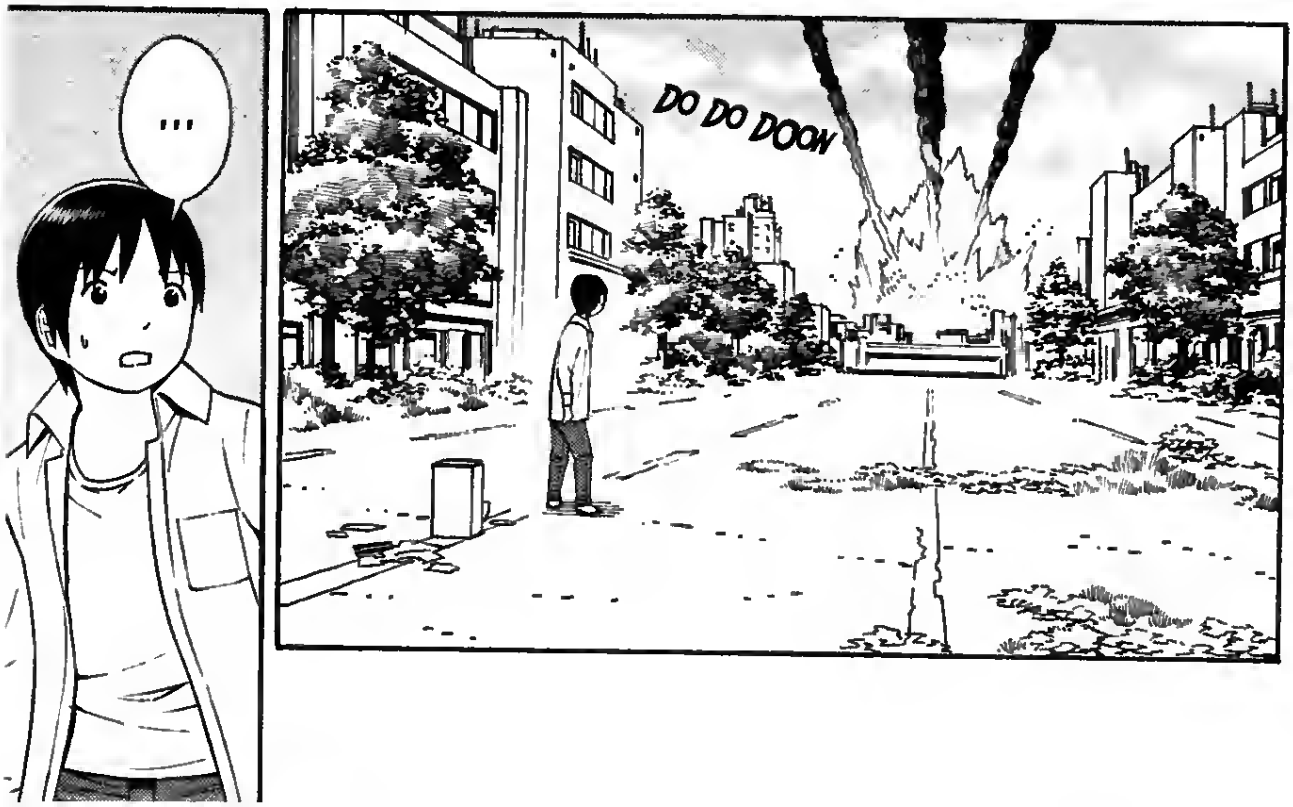
CRAASH!!
GET OUT HERE!!
HURRY UP...
AND TAKE ME TOO.

IT REALLY SEEMS LIKE
THE NUMBER OF STARS IS INCREAS-ING...

SFX: GOOOOOOO - A STRONG CRACKLING ROAR; BIRI BIRI - SHUDDERING



SFX: GOOOO - A CRACKLING ROAR



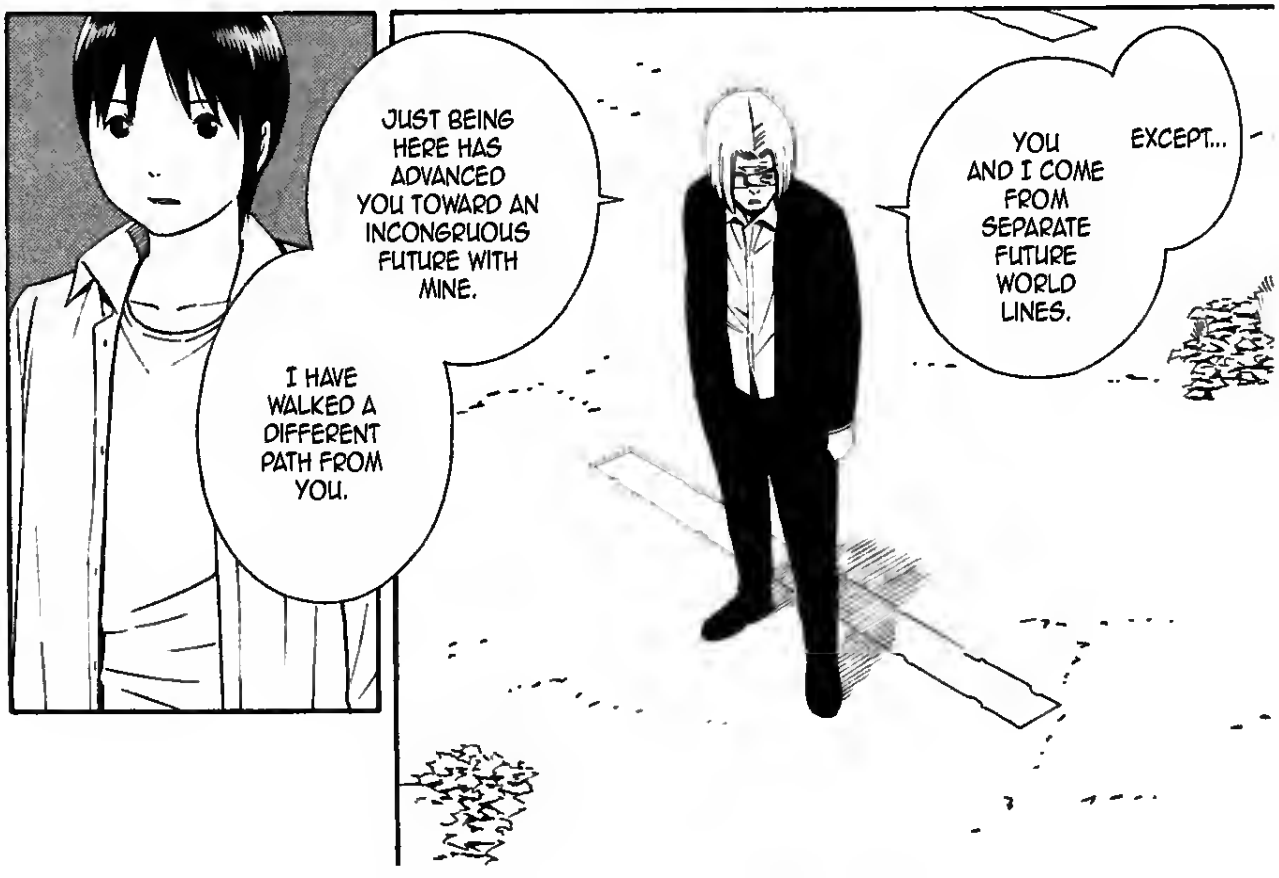
HAVING BEEN DISPLACED FROM THEIR ORBIT, THEY ARE NOW BEING PULLED TOWARD EARTH BY THE SUN'S GRAVITY.
GAMMA RAY BURSTS OF UNKNOWN ORIGIN HAVE DISLODGED SEVERAL PLANETESIMALS FROM THE OORT CLOUD.*

TN: THE OORT CLOUD IS A THEORETICAL CLOUD THAT WRAPS AROUND THE OUTER EDGES OF THE SOLAR SYSTEM. IT IS BELIEVED TO BE COMPOSED OF ICY PLANETISIMALS. SOME OF THESE IN THE OUTERMOST EDGES CAN BE EASILY DISLODGED BY GRAVITATIONAL PULLS, WHICH IN TURN SEND THEM TOWARD THE SOLAR SYSTEM AS COMETS.

SHOULD ALREADY HAVE AN IDEA OF WHO I AM...
YOU...
YOU ARE SOMONE, LIKE ME, WITH THE ABILITY TO FREELY JUMP ACROSS TIME AND SPACE.

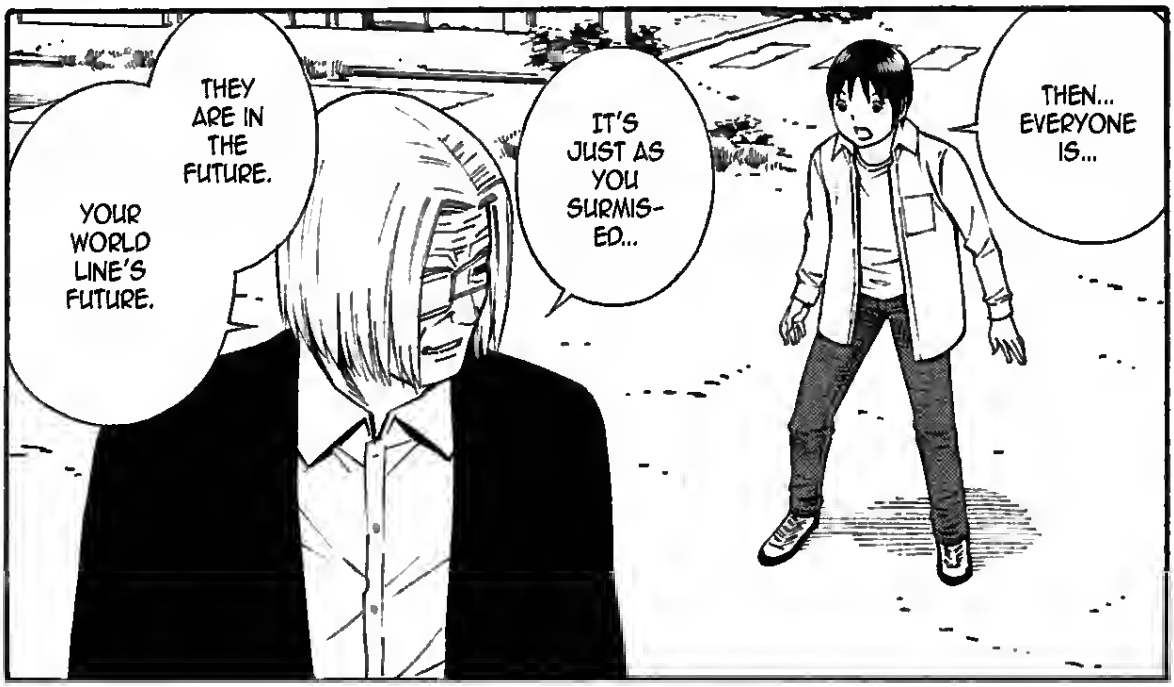
YOU ARE...
MY FUTURE SELF.

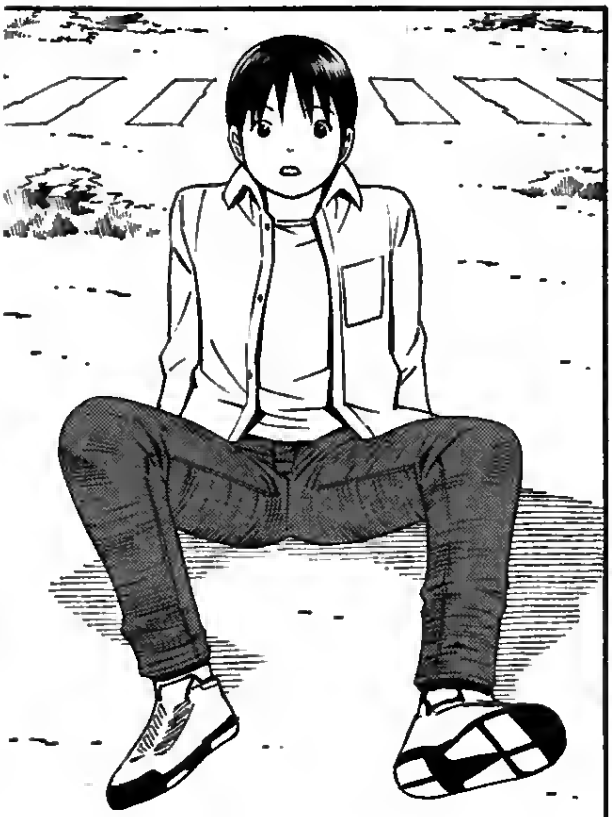
...
YOU ARE CORRECT

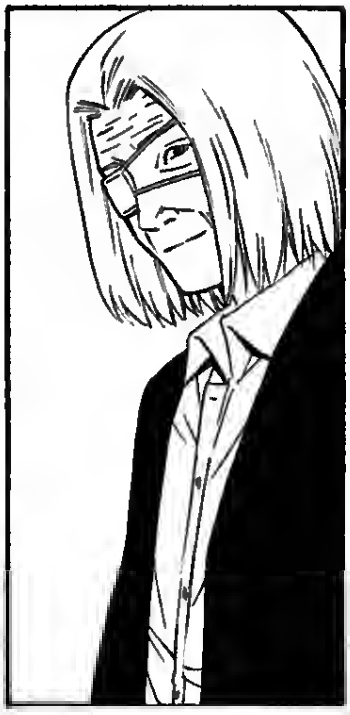

JUST BEING HERE HAS ADVANCED YOU TOWARD AN INCONGRUOUS FUTURE WITH MINE.
I HAVE WALKED A DIFFERENT PATH FROM YOU.
EXCEPT...
YOU AND I COME FROM SEPARATE FUTURE WORLD LINES.

ALLOW ME TO EXPLAIN IN ENTIRETY FROM BEGINNING TO END.
CARE TO...
COMPARE THE DIFFERENCES IN OUR LIVES?
FROM TODAY ONWARD, COUNTLESS METEORITES WILL PLUMMET INTO THE EARTH.
EVERYTHING THAT YOU AND I HAVE EXPERIENCED UNTIL OUR SEVENTEENTH BIRTHDAY WILL HAVE BEEN THE SAME, EXCEPT...
...THERE IS ONE MAJOR DIFFERENCE BETWEEN YOU AND ME.

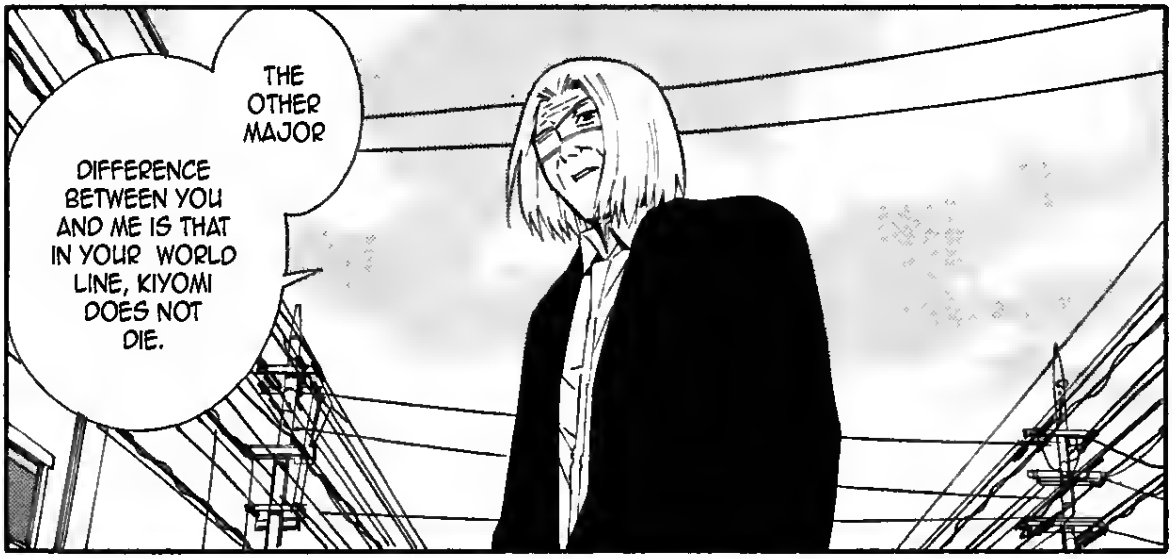
...
WHEN I WAS SEVEN-TEEN...
THERE WERE NO PHANTOMS...
...AND THE METEOR-ITES
CLAIMED COUNTLESS HUMAN LIVES.
THEY WERE SENT HERE BY THE METEORITE SURVIVORS FROM MY WORLD LINE
TO EVACUATE AND SHELTER HUMANKIND FROM THE DESTRUCTIVE FORCE OF THE METEORS.
THEN...
THE PHAN-TOMS WERE...


THEY ARE IN THE FUTURE.
YOUR WORLD LINE'S FUTURE.
IT'S JUST AS YOU SURMISED...
THEN... EVERYONE IS...





I SEE...
SO I WAS RIGHT.


THE OTHER MAJOR DIFFERENCE BETWEEN YOU AND ME IS THAT IN YOUR WORLD LINE, KIYOMI DOES NOT DIE.

KIYOMI... DIES...!?

...!

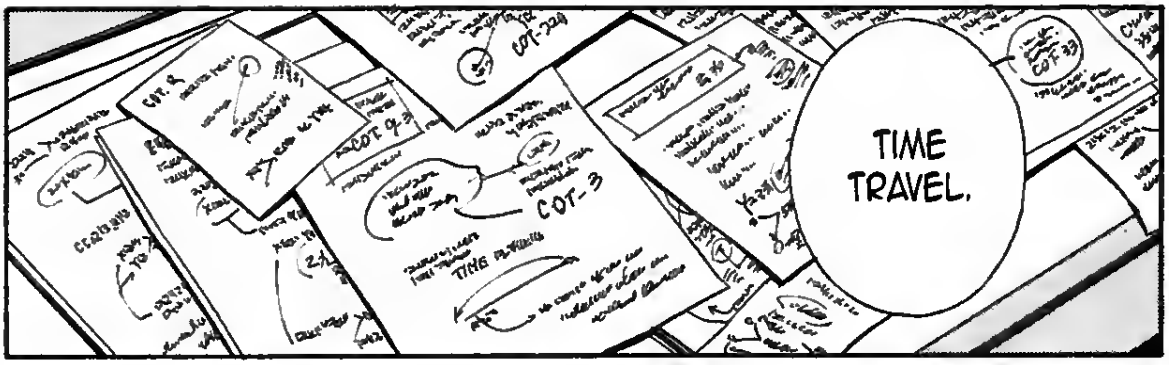
...
THE KIYOMI FROM MY WORLD LINE DIED...
...WHEN SHE WAS JUST NINE YEARS OLD
FOUR YEARS LATER...
I WAS SHIPPED TO WHAT REMAINED OF THE UNITED STATES...
...AND JOINED A GROUP OF RESEARCHERS TRYING TO SAVE HUMANITY FROM THE LINGERING EFFECTS OF THE METEORITES.

THE METEORITES' INFLUENCE WAS MORE THAN EXPECTED.
IN THE WAKE OF THEIR IMPACT, LACK OF ELECTRICITY AND RUNNING WATER LED TO A PANDEMIC THAT RAN RAMPANT THROUGH THE SURVIVORS.
AMONG NUMEROUS OTHER ISSUES, CONSTANT GAMMA BOMBARDMENT AND NUCLEAR FALLOUT HAD LED TO A MUCH MORE SERIOUS ISSUE... POPULATION-WIDE INFERTILITY.

AS SURVIVORS, WE WERE CLINGING TO LIFE SUPPORT.
WE WERE GRASPING AT STRAWS... TRYING TO FIGURE OUT ANY MEANS OF LEAVING BEHIND DESCENDANTS TO CONTINUE THE HUMAN RACE. IN ONE HUNDRED YEARS WE WOULD ALL BE EXTINCT.

IN MY WORLD LINE...
EXTINCTION WAS ALL BUT CERTAIN.

THAT'S WHEN I BEGAN SEARCHING FOR AN ALTERNATIVE METHOD...
SOME-THING THAT WOULD YIELD CONCRETE RESULTS...


TIME TRAVEL.

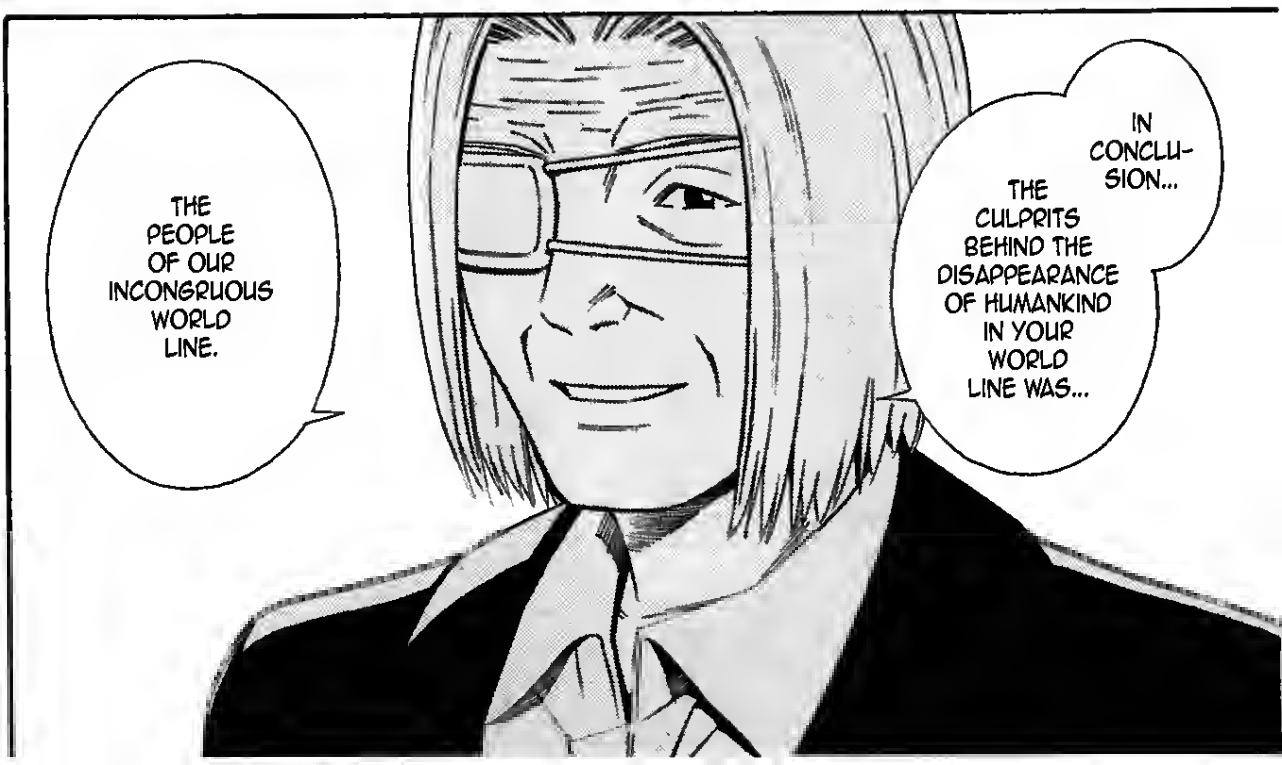
AS A RESULT, ONLY THREE OF THE ORIGINAL RESEARCHERS REQUESTED TO COLLABORATE.
THE OTHER RESEARCHERS DENOUNCED THE THEORY AS FAR TOO ABSTRACT...
I'M SURE YOU KNOW WHO THESE THREE ARE, RIGHT?

I FIGURED THAT BY RETURNING TO THE PAST, WE COULD DEAL WITH THE FALLING METEORITES AND AVERT A CRISIS.

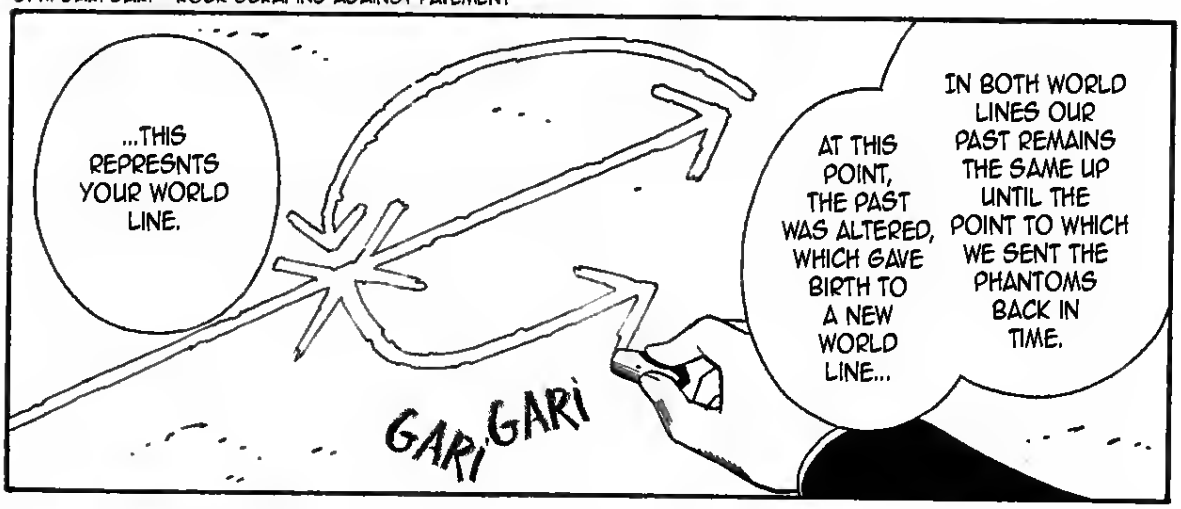
YOU KNOW THE THREE OF THEM JUST AS WELL AS I DO.
SANAE-CHAN...
YAEKO-CHAN...
AND ANNA-CHAN!

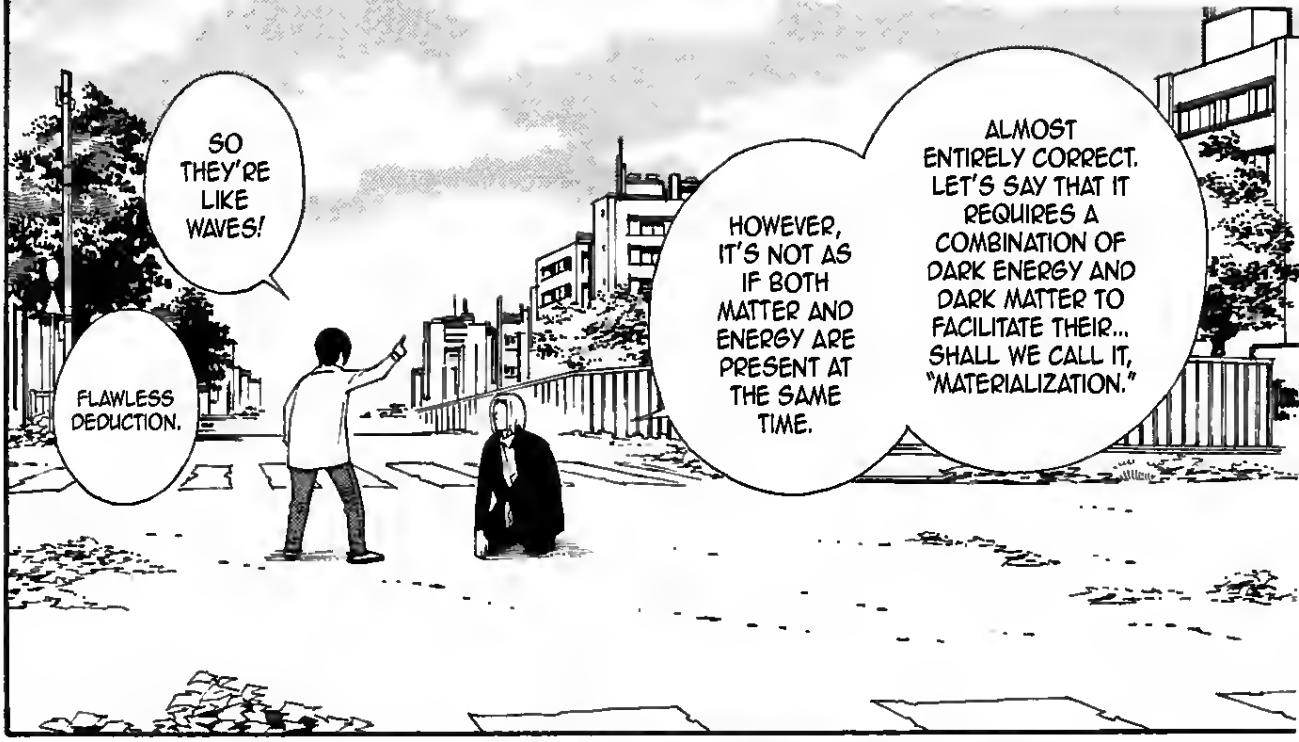
IN MY WORLD LINE AS WELL...
THE FOUR OF US MET
PRECISE-LY.
FROM THAT MOMENT ON, TIME TRAVEL WAS NO LONGER A MERE PREDICTION. IT BECAME REALITY.
THE COTILLARD CONJECTURE.
TOGETHER WE UNRAVELED THE MYSTERY AND FOUNDATION OF TIME TRAVEL....
TO CREATE A TIME TRAVEL SYSTEM, WHICH YOU REFER TO AS...
IN AN INSTANT, ENTIRE RESEARCH DIVISIONS OF SCIENTISTS BEGAN TO WORK TOGETHER
THE COTILLARD CONJECTURE PREDICTS TIME TRAVEL...

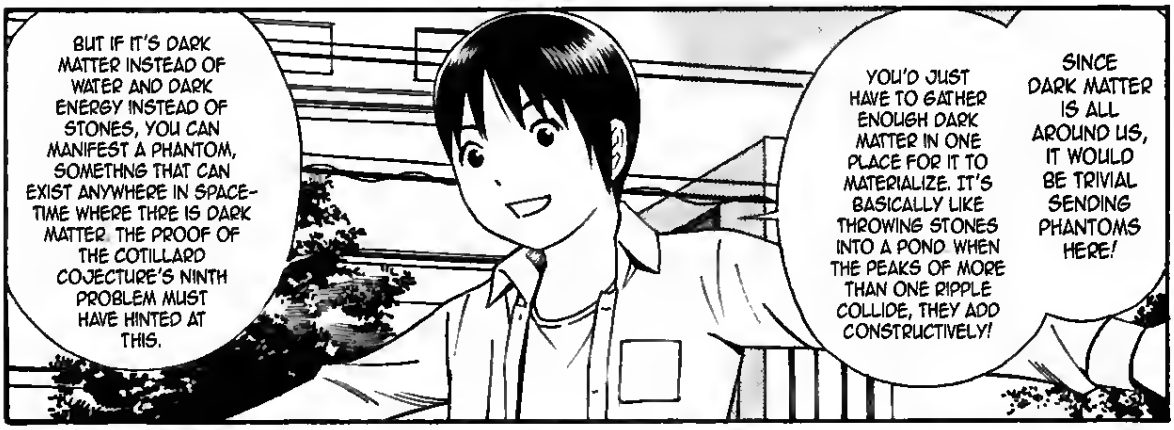
PHANTOMS.

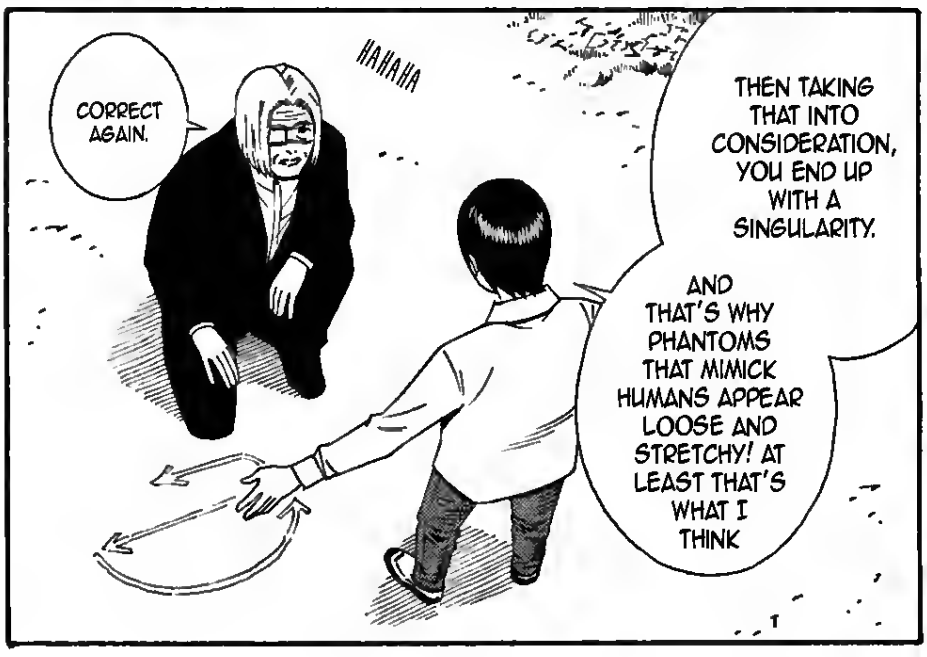

IN CONCLU-SION...
THE CULPRITS BEHIND THE DISAPPEARANCE OF HUMANKIND IN YOUR WORLD LINE WAS...
THE PEOPLE OF OUR INCONGRUOUS WORLD LINE.

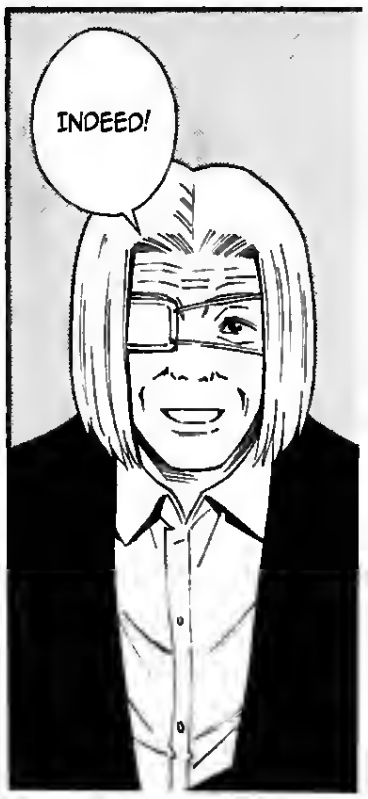
SFX: GARI GARI - ROCK SCRAPING AGAINST PAVEMENT


...THIS REPRESNTS YOUR WORLD LINE.
GARI GARI
AT THIS POINT, THE PAST WAS ALTERED, WHICH GAVE BIRTH TO A NEW WORLD LINE...
IN BOTH WORLD LINES OUR PAST REMAINS THE SAME UP UNTIL THE POINT TO WHICH WE SENT THE PHANTOMS BACK IN TIME.

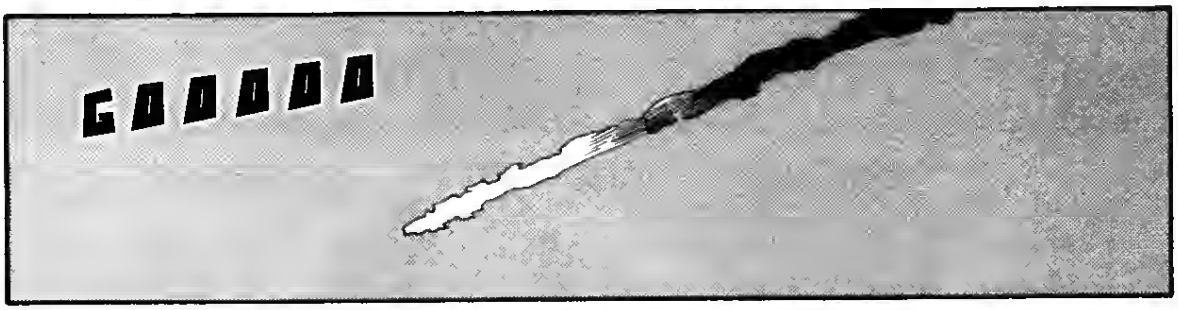

SO THEY'RE LIKE WAVES!
FLAWLESS DEDUCTION.
HOWEVER, IT'S NOT AS IF BOTH MATTER AND ENERGY ARE PRESENT AT THE SAME TIME.
ALMOST ENTIRELY CORRECT. LET'S SAY THAT IT REQUIRES A COMBINATION OF DARK ENERGY AND DARK MATTER TO FACILITATE THEIR... SHALL WE CALL IT, "MATERIALIZATION."


BUT IF IT'S DARK MATTER INSTEAD OF WATER AND DARK ENERGY INSTEAD OF STONES, YOU CAN MANIFEST A PHANTOM, SOMETHNG THAT CAN EXIST ANYWHERE IN SPACE-TIME WHERE THRE IS DARK MATTER. THE PROOF OF THE COTILLARD COJECTURE'S NINTH PROBLEM MUST HAVE HINTED AT THIS.
YOU'D JUST HAVE TO GATHER ENOUGH DARK MATTER IN ONE PLACE FOR IT TO MATERIALIZE. IT'S BASICALLY LIKE THROWING STONES INTO A POND WHEN THE PEAKS OF MORE THAN ONE RIPPLE COLLIDE, THEY ADD CONSTRUCTIVELY!
SINCE DARK MATTER IS ALL AROUND US, IT WOULD BE TRIVIAL SENDING PHANTOMS HERE!

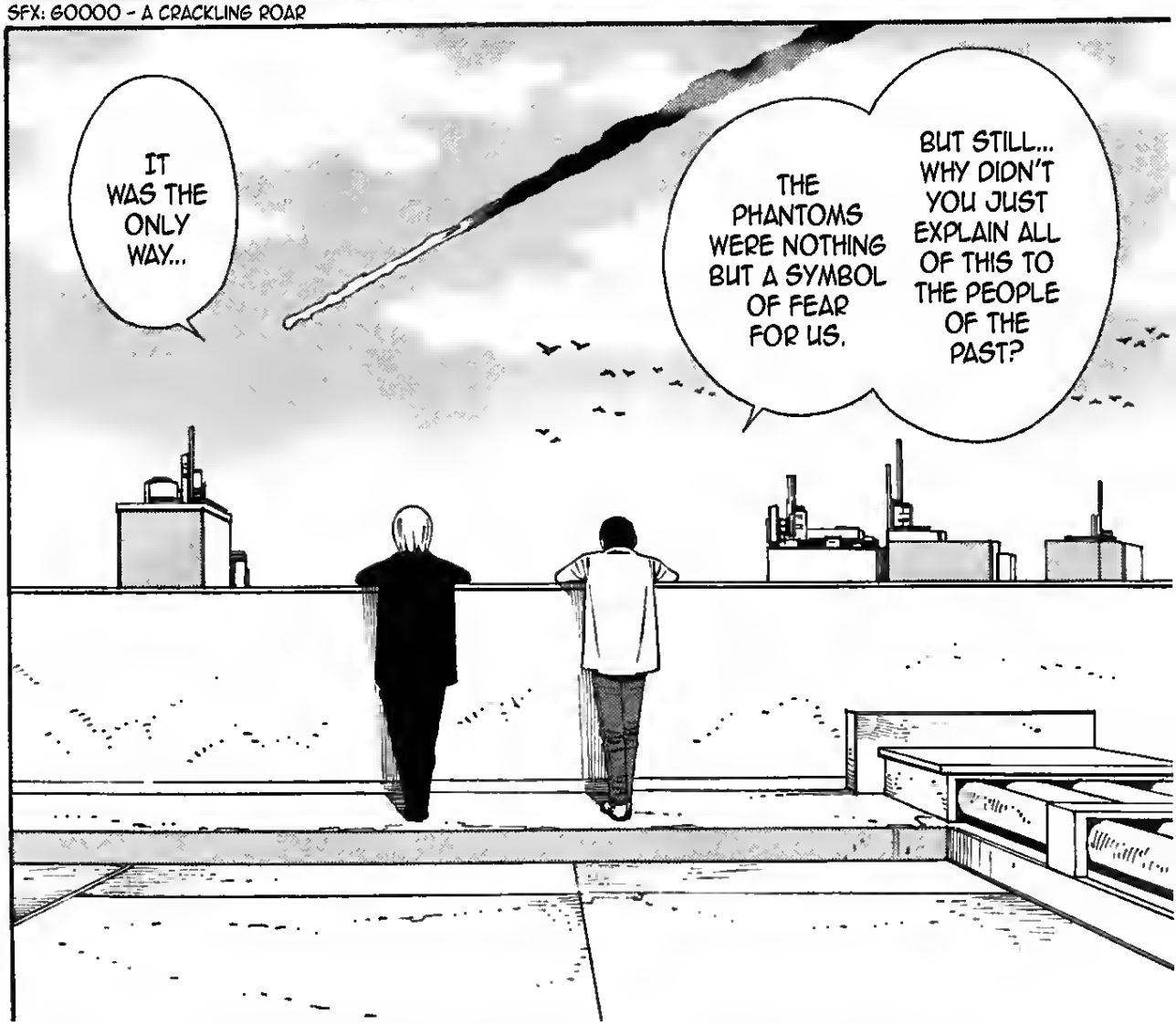

CORRECT AGAIN.
HAHAHA
THEN TAKING THAT INTO CONSIDERATION, YOU END UP WITH A SINGULARITY.
AND THAT'S WHY PHANTOMS THAT MIMICK HUMANS APPEAR LOOSE AND STRETCHY! AT LEAST THAT'S WHAT I THINK

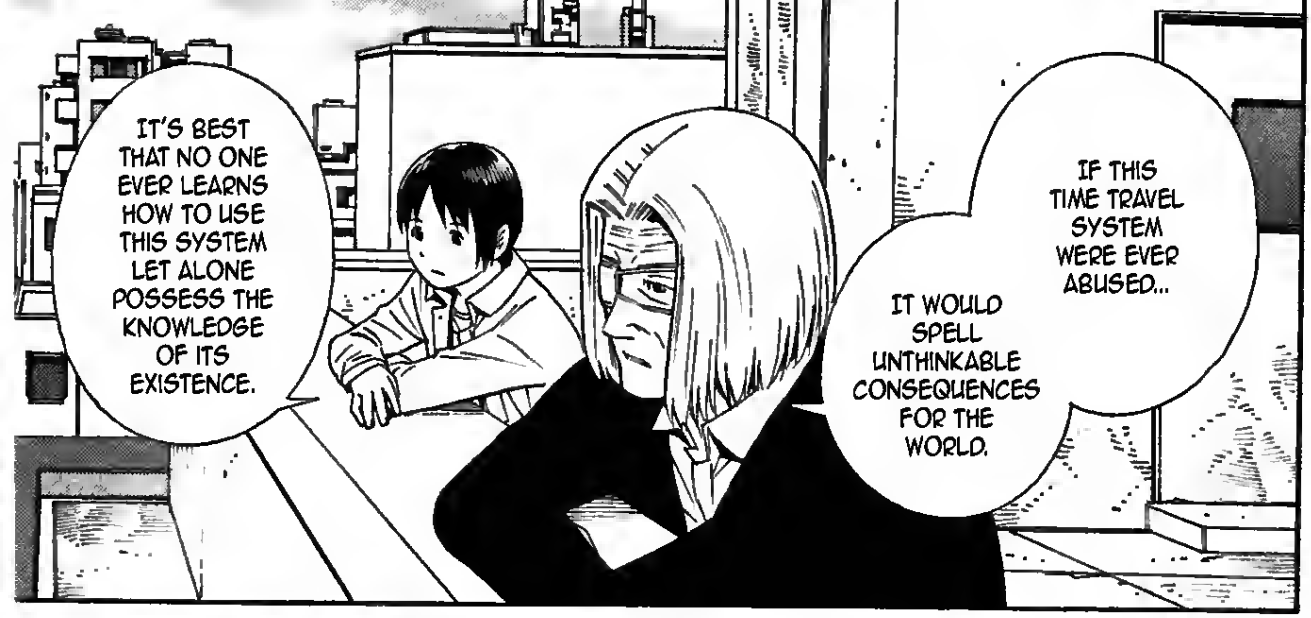

INDEED!

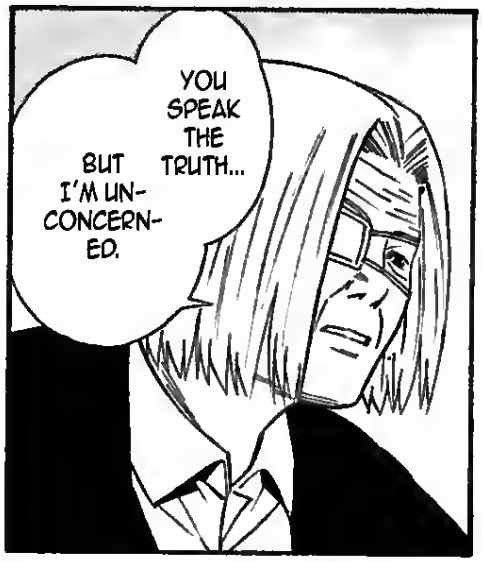
WHAT YOU SEE AND WHAT IS ACTUALLY HAPPENING WITHIN COULD BE TOTALLY DIFFERENT.
DUE TO ITS SCHWARTZ-CHILD RADIUS AN EVENT HORIZON EXISTS, RIGHT?
HUMAN SIGHT RELIES ON THE PERCEPTION OF LIGHT, MORE SPECFICALLY PHOTONS.
CONSE-QUENTLY, SOMETHING SIMILAR TO AN EVENT HORIZON DISTORTS WHAT IS CAPABLE OF BEING SEEN NEAR THE PHANTOMS CORE.
THEN... YOU HAVE TRULY MASTERED THE PHYSICAL IMPLICATIONS OF THE CONJECTURE?
MY MY...
I COULDN'T HAVE EXPLAINED IT ANY BETTER MYSELF.
THE "UNSTABLE PHANTOMS!"
WHAT?
BECAUSE PHANTOMS ARE MUCH SMALLER BLACK HOLES, "HAWKING RADIATION" QUICKLY CAUSES THE SINGULARITY TO COLLAPSE AND IMPLODE.
THAT'S PRECISELY WHAT WE BELIEVED TOO. TO SOME EXTENT THAT'S TRUE, BUT THERE IS A MINOR CAVEAT.
I SUPPOSE THAT IN THEORY, THERE SHOULDN'T BE MUCH DIFFERENCE BETWEEN CONTROLLING PHANTOMS AND BLACK HOLES.



SFX: GOOOO - A CRACKLING ROAR


IT WAS THE ONLY WAY...
THE PHANTOMS WERE NOTHING BUT A SYMBOL OF FEAR FOR US.
BUT STILL... WHY DIDN'T YOU JUST EXPLAIN ALL OF THIS TO THE PEOPLE OF THE PAST?


IT'S BEST THAT NO ONE EVER LEARNS HOW TO USE THIS SYSTEM LET ALONE POSSESS THE KNOWLEDGE OF ITS EXISTENCE.
IF THIS TIME TRAVEL SYSTEM WERE EVER ABUSED...
IT WOULD SPELL UNTHINKABLE CONSEQUENCES FOR THE WORLD.

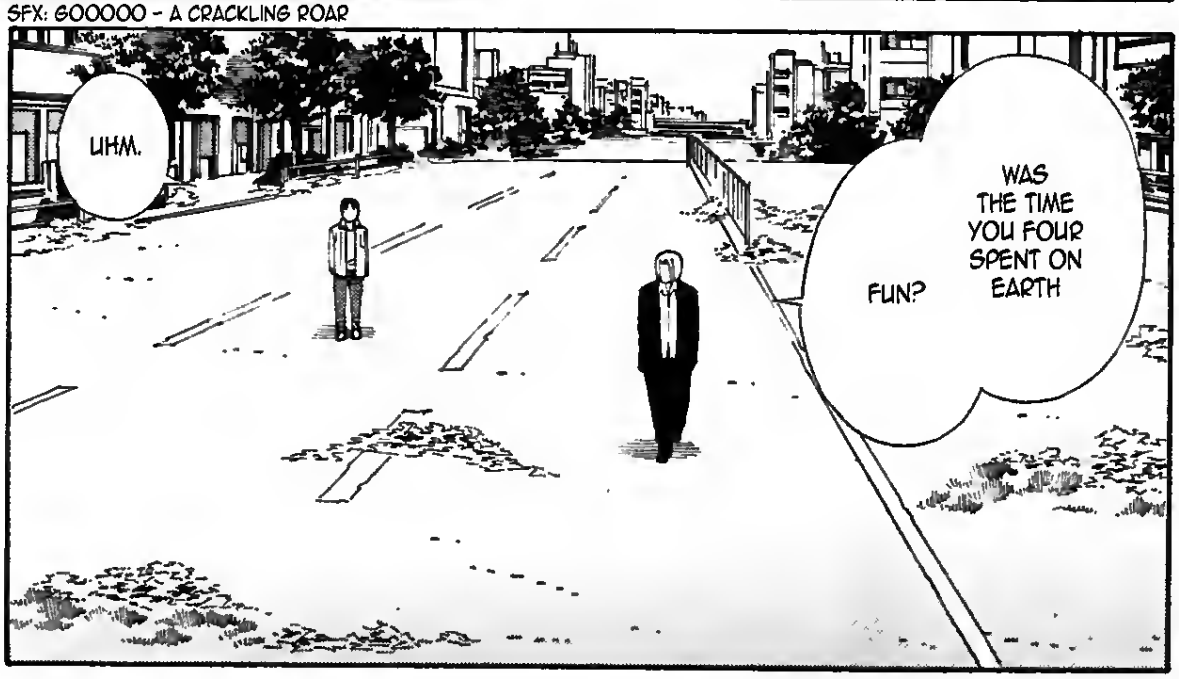

YOU SPEAK THE TRUTH...
BUT I'M UN-CONCERN-ED.

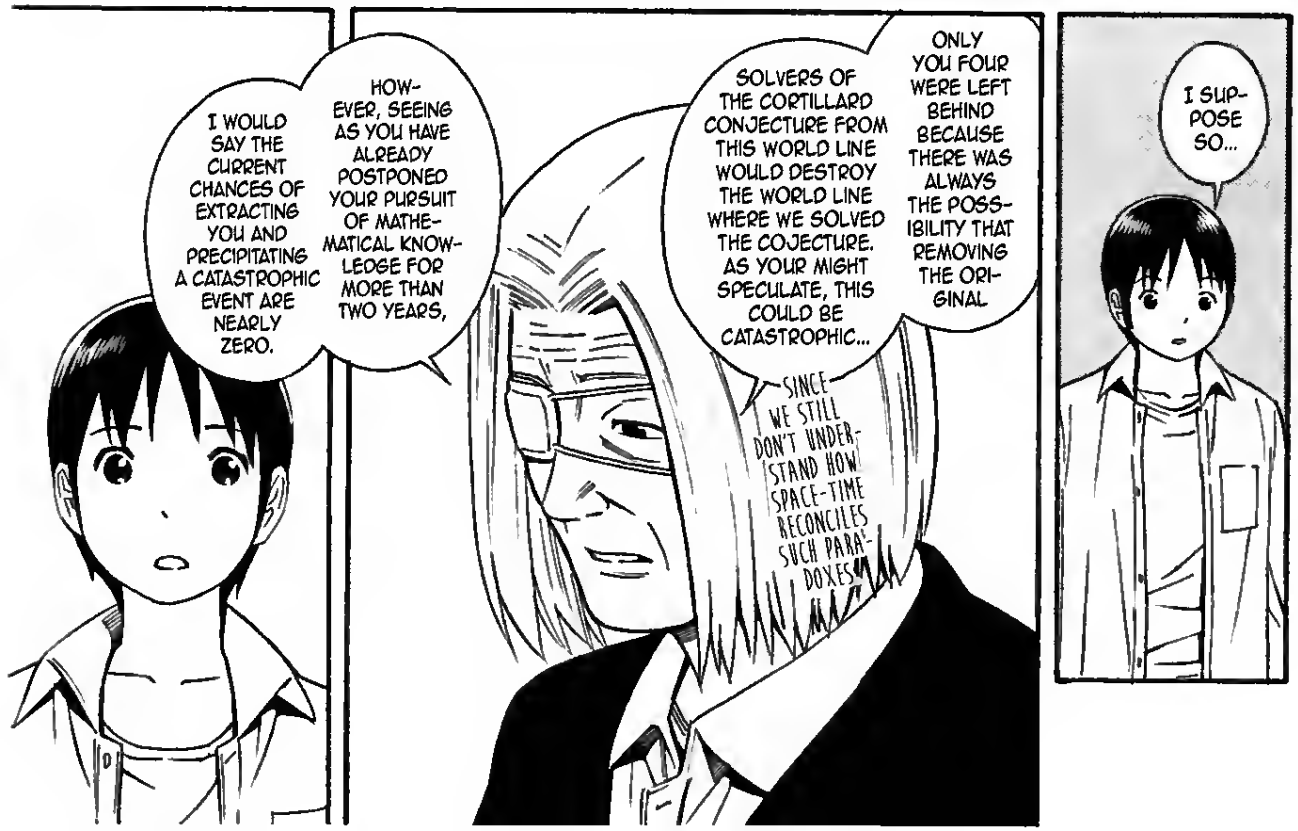
TRUE...
BUT THE PEOPLE FROM YOUR WORLD LINE BUILT THIS SYSTEM AND HAVE TOTAL ACCESS TO IT. YOU CAN'T UNDO WHAT THEY KNOW.

...DURING THAT TIME
MOST OF MY FELLOW RESEARCHERS PASSED AWAY.
DA DOON
THE TIME IT TOOK TO BUILD THE SYSTEM WAS GREAT AND...

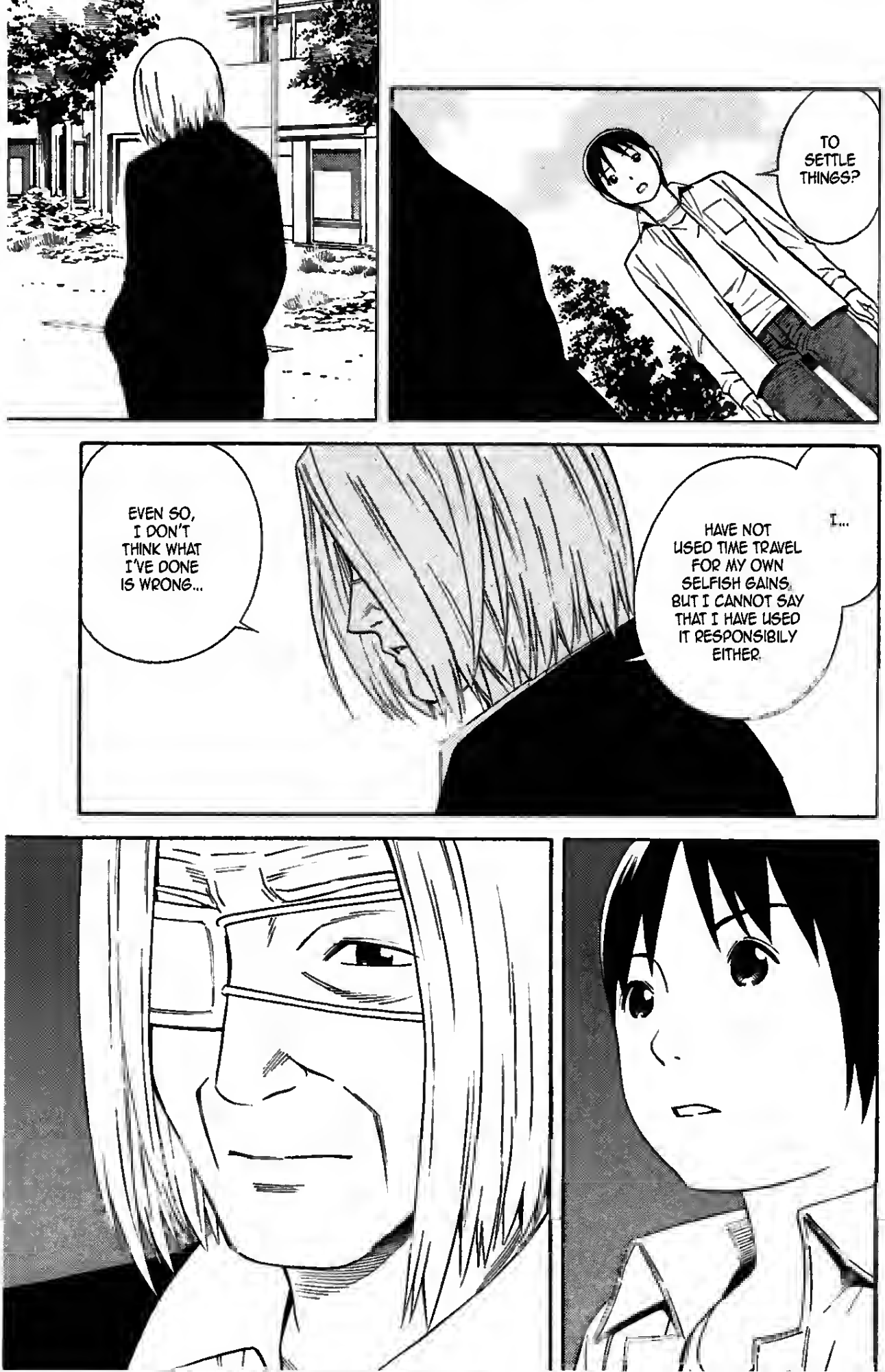
I'M ABOUT THE ONLY PERSON CARRYING OUT THIS PLAN RIGHT NOW AND HAVE BEEN FOR QUITE SOME YEARS SINCE I FIRST ARRIVED IN THIS WORLD LINE.
THERE WERE SO MANY PREPARATIONS TO MAKE. UNFORTUNATELY, THERE WAS NO WAY TO EXPLAIN TO THE PEOPLE OF THIS TIME WHAT I WAS DOING.
IT APPEARS THAT I OVERDID IT A LITTLE...
IT SEEMS... THAT A LOT OF THINGS DIDN'T GO AS PLANNED.
SORRY ABOUT THAT
IT WAS RATHER HORRIFYING SEEING YOUR FRIENDS AND FAMILY DISTORT AT IMPOSSIBLE ANGLES
PHANTOMS COULD MIMIC THE LOOKS OF PEOPLE TO MORE EASILY SHUTTLE THEM TO THE FUTURE, BUT THAT SEEMED TO HAVE AN UNINTENDED FEAR FACTOR.
BELIEVE ME. IT WAS NEVER MY INTENTION TO FRIGHTEN THE PEOPLE HERE. I EVEN ATTEMPTED TO USE THE CORTILLARD PHENOMENON SO THAT

SFX: GOOOOO - A CRACKLING ROAR




I WOULD SAY THE CURRENT CHANCES OF EXTRACTING YOU AND PRECIPITATING A CATASTROPHIC EVENT ARE NEARLY ZERO.
HOWEVER, SEEING AS YOU HAVE ALREADY POSTPONED YOUR PURSUIT OF MATHEMATICAL KNOWLEDGE FOR MORE THAN TWO YEARS,
SOLVERS OF THE CORTILLARD CONJECTURE FROM THIS WORLD LINE WOULD DESTROY THE WORLD LINE WHERE WE SOLVED THE COJECTURE. AS YOUR MIGHT SPECULATE, THIS COULD BE CATASTROPHIC...
ONLY YOU FOUR WERE LEFT BEHIND BECAUSE THERE WAS ALWAYS THE POSSIBILITY THAT REMOVING THE ORIGINAL
SINCE WE STILL DON'T UNDERSTAND HOW SPACE-TIME RECONCILES SUCH PARADOXES
I SUPPOSE SO...

THIS IS GOING TO BE HARD FOR YOU TO HEAR, BUT...
USING THE COTILLARD CONJECTURE IN THE WRONG MANNER IS DANGEROUS.
AFTER CONFIRMING THAT A CASTROPHIC EVENT IS OUTSIDE THE RANGE OF POSSIBILITY, WHY DID YOU TAKE THE OTHERS, BUT LEAVE ME BEHIND?
TO SETTLE THINGS... ONCE AND FOR ALL...
CAN YOU ANSWER THAT?
WHY DID YOU LEAVE *ONLY* ME BEHIND?


TO SETTLE THINGS?
I...
HAVE NOT USED TIME TRAVEL FOR MY OWN SELFISH GAINS, BUT I CANNOT SAY THAT I HAVE USED IT RESPONSIBILY EITHER.
EVEN SO, I DON'T THINK WHAT I'VE DONE IS WRONG...

HOWEVER...
I HAVE TO DO EVERYTHING IN MY POWER TO ENSURE THAT IT NEVER COMES TO EXIST.

TRANSLATION NOTES

WHERE TO BEGIN THIS CHAPTER... I GUESS WE'LL START WITH:

THE OORT CLOUD (P. 67)

AS MENTIONED THE OORT CLOUD IS A LARGE THEORETICAL CLOUD OF ICY PLANETESIMALS THAT SURROUNDS OUR SOLAR SYSTEM. I SAY THEORETICAL BECAUSE HUMANS AS A SPECIES HAVE YET TO DIRECTLY WITNESS THE CLOUD, BUT GATHERED DATA SUGGESTS ITS EXISTENCE. CURRENTLY, VOYAGER 1, A SPACE PROBE LAUNCHED IN 1977 WILL REACH THE OORT CLOUD IN ABOUT 300 YEARS (FROM 2017). THE OORT CLOUDS THICKNESS IS PROJECT TO BE ABOUT A MASSIVE 95,000 ASTRONOMICAL UNITS, WHICH IS 8.8 TRILLION MILES OR ABOUT 14.2 TRILLION KILOMETERS. VOYAGER 1, WHICH MOVES AT THE CURRENT SPEED OF 17,030 METERS/SECOND (38 MILLION MILES PER HOUR OR 61.2 MILLION KILOMETERS PER HOUR), WOULD TAKE ABOUT 30,000 YEARS TO PASS THROUGH THE OORT CLOUD. THIS GIVES YOU AN IDEA OF HOW EXPANSIVE THE OORT CLOUD AND SPACE AS A WHOLE IS.

THEREFORE, ANY PLANETESIMAL THAT WOULD HAVE BECOME DISLODGED FROM THE OORT CLOUSE WOULD HAVE BEEN TRAVELING TOWARD EARTH FOR QUITE SOME TIME BEFORE REACHING IT. THE QUESTION WOULD THEN BECOME WHY DIDN'T ANYONE ON EARTH NOTICE THESE APPROACHING PLANETESIMALS? WELL, FUTURE MASASHI DOES MENTION THAT GAMMA RAY BURSTS DISLODGED THEM IN THE FIRST PLACE. THIS IS PURE SPECULATION, BUT ANY GAMMA BURST THAT POWERFUL WOULD LIKELY ALSO HAVE DAMAGED SATTELIGHTS AND OTHER EXTRATERRESTRIAL EQUIPEMENT NECESSARY TO DETECT THEM. ALTERNATVELY, IT'S POSSIBLE THAT THE SCIENTISTS WHO MIGHT HAVE DETECTED THE APPROACHING PLANETESIMALS ADVISED GOVERNMENTS NOT TO DO ANYTHING BECAUSE DETONATING THEM WOULD SIMPLY MAKE MATTERS WORSE. I HAVE NO REAL EXPLANATION FOR THIS AND SEEING AS HOW THE AUTHOR DIDN'T EXPLAIN IT, MY GUESS IS THAT THERE WERE SO MANY PLANETESIMALS HEADING TOWARD EARTH THAT NOTHING COULD REALLY BE DONE ABOUT IT. IT WOULD BE LIKE TRYING TO CATCH A HANDFUL OF PEBBLES THAT SOMEONE THREW AT YOU: YOU MIGHT STOP SOME, BUT THE VAST MAJORITY ARE STILL GOING TO STRIKE YOU AND IT'S GOING TO HURT.

GAMMA RADIATION AND GAMMA-RAY BURSTS (P. 67)

GAMMA RADIATION IS PRODUCED BY THE RADIOACTIVE DECAY OF NUCLEI. IT CONSISTS OF PHOTONS (LIGHT PARTICLES) EXCITED TO THE HIGHEST ENERGY LEVELS. ON EARTH, GAMMA RADIATION IS OBSERVED FROM GAMMA DECAY FROM RADIOACTIVE NUCLEI, NUCLEAR DETONATIONS, AND SOMETIMES LIGHTNING. IN SPACE, GAMMA RADIATION OCCURS IN STARS DUE TO NUCLEAR FUSION AT THEIR CORE, IN BLAZARS (COMPACT QUASARS), AND IN SUPER- AND HYPER-NOVAE AS A HIGH MASS STAR COLLAPSES. GAMMA-RAY BURSTS ARE THE BRIGHTEST OF GAMMA RADIATION EMISSION EVENTS AND ARE BELIEVED TO BE RELEASED DURING THE COLLAPSE OF MASSIVE STARS DURING A SUPERNOVA EVENT. DURING THIS PERIOD OF TIME, A SINGLE STAR CAN RELEASE AS MUCH ENERGY AS OUR SUN WILL DURING ITS ENTIRE 10

TRANSLATION NOTES

GAMMA RADIATION AND GAMMA-RAY BURSTS (CONT'D)

BILLION YEAR LIFESPAN. IT IS THOUGHT THAT RECEIVING A FULL BLAST OF GAMMA-RAY BURST RADIATION ON EARTH WOULD LEAD TO MASS EXTINCTION. IT HAS BEEN HYPOTHESIZED THAT THE MAJOR ORDOVICIAN-SILURIAN EXTINCTIONS QUITE POSSIBLY OCCURED DUE SUCH A GAMMA-RAY BURST WHICH DESTROYED MUCH OF THE OZONE LAYER WHICH CAUSED THE PLANET TO COOL TO LEVELS INCAPABLE OF BEING TOLERATED BY THE EARTH'S CURRENT SPECIES. HOWEVER, A MASSIVE SOLAR FLARE FROM OUR OWN SUN COULD ALSO HAVE CAUSED THIS EVENT DUE TO ITS PROXIMITY DESPITE HAVING CONSIDERABLY LOWER ENERGY THAN A SUPERNOVA GAMMA-RAY BURST.

FUTURE MASASHI'S WORLD LINE PROBLEMS (P. 75)

THE APPOCALYPTIC SCENARIO DESCRIBED BY MASASHI'S FUTURE SELF SEEMS QUITE REASONABLE. FIRST, ASSUMING THAT THE METEORITES ARE NOT LARGE ENOUGH TO ACTUALLY DISLODGE THE EARTH FROM ITS ORBIT OR KICK UP ENOUGH DUST TO BLOCK OUT THE SUN LEADING TO A RAPID EXTINCTION, THE METEORITES WOULD CAUSE TREMENDOUS CASUALTIES AND WIDESPREAD DAMAGE ACROSS THE PLANET. THE WORST OF THIS DAMAGE WOULD BE FELT BY THE SURVIVORS AS THE METEORITES WOULD DESTROY PIPES AND PLUMBING PREVENTING SURVIVORS FROM HAVING A CONVENIENT SUPPLY OF FRESH WATER AND WOULD MITIGATE THE REMOVAL OF WASTE.

ADD TO THIS THAT THE METEORITES WOULD HAVE DESTROYED WORLD POWER GRIDS, CAUSED UNEXPECTED DETONATIONS OF NUCLEAR STOCKPILES, AND THE CONSTANT BOMBARDMENT OF GAMMA RADIATION, AND THEIR IS LITTLE CHANCE THAT ANY ELECTRONICS WORK AT ALL. NO POWER GRID, NO ELECTRICITY TO POWER ELECTRONICS. EVEN IF YOU HAD BATTERIES, THE NUCLEAR EXPLOSIONS WOULD HAVE GENERATED ELECTROMAGNETIC PULSES (EMP) THAT WOULD HAVE DESTROYED ELECTRONIC CIRCUITRY. ANYTHING NOT DESTROYED PHYSICALLY OR BY EMP WOULD BE EXPOSED TO GAMMA-RAY BURST RADIATION AND DESTROYED.

TO MY KNOWLEDGE, MOST ELECTRONICS IN SPACE UTILIZE SPECIALLY DEVELOPED TRANSISTORS THAT ARE COMPOSED OF GALLIUM ARSENIDE TO MAKE THEM MORE RESISTANT TO GAMMA RADIATION THAT WOULD OTHERWISE BE FILTERED OUT BY OUR OZONE LAYER ON EARTH. DUE TO THIS OZONE LAYER, WE CAN USE SILICON TRANSISTORS ON EARTH WITHOUT MUCH CONSEQUENCE, BUT SHOULD WE HAVE A MASSIVE BURST OF GAMMA RADIATION WE COULD EASILY LOSE OUR ELECTRONICS. GALLIUM ARSENIDE, THOUGH NOT AS WELL DEVELOPED AS SILICON, IS MORE RESISTANT TO GAMMA RADIATION BECAUSE IT HAS A HIGHER BAND GAP THAT CAN ABSORB HIGHER LEVELS OF ENERGY WITHOUT DAMAGING THE TRANSISTOR'S STRUCTURE.

AS SOON AS WE LOSE, ELECTRICITY AND RUNNING WATER, WE ARE PRETTY MUCH ARE RETURNED TO THE DARK AGES. WITHOUT ELECTRICITY, WE CAN NO LONGER

TRANSLATION NOTES

FUTURE MASASHI'S WORLD LINE PROBLEMS (CONT'D)

MANUFACTURE ANTIBIOTICS TO COMBAT PATHOGENIC OUTBREAKS. WITHOUT RUNNING WATER, WE END UP LIVING AMONG OUR OWN REFUSE AND DISEASE SPREADS MUCH EASIER WHEN THE WATER YOU USE TO WASH YOUR HANDS BECOMES THE WATER YOU DRINK TO STAY ALIVE. WATER SHORTAGES MIGHT FORCE INDIVIDUALS TO CHOOSE BETWEEN CLEANLINESS AND HYDRATION TO SURVIVE.

FINALLY, BETWEEN THE GAMMA RADIATION AND THE NUCLEAR DETONATIONS, THERE IS A GOOD CHANCE THAT MANY PEOPLE WOULD HAVE BEEN STERILIZED AND BE UNABLE TO REPRODUCE. THE WORLD THAT THE FUTURE MASASHI LIVES IN IS TRULY FRIGHTENING WHEN YOU STOP TO CONSIDER HOW MUCH WE RELY ON ELECTRICITY FOR MANUFACTURING, TRANSPORT, DATA INQUIRY (AND RESEARCH), MEDICINE (HOSPITALS AND DRUG PRODUCTION), ETC; AND HOW MUCH WE RELY AND EXPECT A STEADY FLOW OF FRESH WATER IN ORDER TO SHOWER, BATHE, DRINK, COOK, ETC. PLUS, PROCESSING AND CLEANING THE WATER REQUIRES ELECTRICITY TOO, SO THAT MAKES IT EVEN MORE DIFFICULT.

WORLD LINE

THE TERM WORLD LINE IS USED PRETTY SUBSTANTIALLY DURING THIS CHAPTER. IN PHYSICS, A WORLD LINE TYPICALLY REFERS TO THE PATH OF AN OBJECT IN FOUR DIMENSIONAL SPACE. IN OTHER WORDS, THE EXISTENCE OF AN OBJECT (AS WE PERCIEVE IT, I'LL COME BACK TO THIS LATER) CAN BE MEASURED WITH FOUR COORDINATES: AN X, Y, AND Z COORDINATE THAT RESPECTIVELY DESCRIBE WHERE YOU ARE IN SPACE AND A TIME COORDINATE THAT DESCRIBES WHEN YOU WERE AT A PARTICULAR LOCATION. FOR EXAMPLE, ONE COULD MAP YOUR MOVEMENT THROUGH SPACE ON PLANET EARTH AS FOLLOWS: X -> MOVING LEFT OF RIGHT, Y -> MOVING FORWARD OR BACKWARD, Z -> MOVING UP (INTO THE SKY) OR DOWN (THROUGH THE GROUND), AND T -> WHEN YOU WERE AT THAT POSITION.

AS AN EXAMPLE, LET'S SAY THAT YOU ARE AT SCHOOL OR WORK. YOU MIGHT SIT IN THE SAME DESK EVERY DAY IN WHICH EACH DAY YOUR X,Y, AND Z COORDINATES RELATIVE TO EARTH (RELATIVE BECAUSE TECHNICALLY OUR PLANET IS MOVING TOO) WOULD BE THE SAME. HOWEVER, THE TIME COORDINATE WOULD VARY BECAUSE EACH DAY IS DIFFERENT. THOUGH YOU SAT IN THE THE DESK YESTERDAY, TODAY, AND WILL DO SO AGAIN TOMORROW, YOU WILL DO SO ON DIFFERENT DAYS. EACH OF THESE POINTS CORRESPONDS TO A SPECFIC POINT IN SPACE AND TIME. IN THIS EXAMPLE, TIME IS THE ONLY VARIABLE PART.

NOW, A WORLD LINE WOULD HOLD FOR HIGHER DIMENSIONS AS WELL WHERE YOU MIGHT HAVE EVEN MORE VARIABLES. SUCH SPECULATION ABOUT FURTHER DIMENSIONS WOULD HOLD GREATER RELEVANCE IN THE PRESENCE OF STRING THEORY OR THE MULTIVERSE. IN THIS PARTICULAR INSTANCE BECAUSE WE ARE DEALING WITH MORE THAN ONE UNIVERSE, WE MIGHT BE ABLE TO SAY THAT THE FUTURE MASASHI

TRANSLATION NOTES

WORLD LINE (CONT'D)

AND OUR MASASHI COME FROM SEPARATE UNIVERSES. IN THIS CASE, WE KNOW THAT EACH UNIVERSE HAS AT LEAST FOUR DIMENSIONS (X, Y, Z, T), BUT SINCE WE KNOW THAT DIFFERENT THINGS OCCURRED IN DIFFERENT UNIVERSES AT THE SAME TIME THERE IS MUST BE A FIFTH DIMENSION.

IF YOU ARE WONDERING WHY IT COULDN'T BE THE SAME UNIVERSE, JUST THAT THE SPACE COORDINATES WERE ALTERED AND THE TIME COORDINATE REMAINED THE SAME, CONSIDER THER FOLLOWING:

LET FUTURE MASASHI'S POSITION IN UNIVERSE 1 BE DESCRIBED AS (X1, Y1, Z1, T1). LET OUR (PRESENT DAY) MASASHI'S POSITION IN UNIVERSE 2 BE DESCRIBED AS (X2, Y2, Z2, T2).

UP UNTIL THE POINT THAT OUR MASASHI ENCOUNTERED THE PHANTOMS, BOTH MASASHI'S HAD A WORLD LINE IN WHICH (X1, Y1, Z1, T1) = (X2, Y2, Z2, T2). AFTER THIS POINT, THIS WAS NO LONGER TRUE. AT THIS POINT, THE TIME COORDINATE T1 = T2 REMAINED TRUE, BUT THE SPACE COORDINATES (X1, Y1, Z1) $\neq$ (X2, Y2, Z2). NORMALLY, THIS WOULD SUGGEST THAT BOTH MASASHI'S LIVED AT THE SAME TIME, BUT WERE AT DIFFERENT LOCATIONS. HOWEVER, WE KNOW THAT IT WAS NOT POSSIBLE FOR THERE TO BE TWO MASAHI'S WITHIN THE SAME UNIVERSE SINCE UP UNTIL THE PHANTOMS ARRIVED, THERE WOULD HAVE ONLY BEEN ONE MASASHI. THIS SUGGESTS THAT AT THIS POINT, ANOTHER EXISTENCE WAS CREATED TO FULFILL THE POSSIBILITY IN WHICH (X1, Y1, Z1) $\neq$ (X2, Y2, Z2) WHILE T1 = T2 REMAINED THE SAME. THIS EXISTENCE AS MASASHI POSTULATES IS ANOTHER UNIVERSE. BY CREATING A NEW UNIVERSE, WE CAN RE-EXAMINE THIS SUCH THAT THERE IS ANOTHER DIMENSION "N." SO WHILE OUR MASASHI AND THE FUTURE MASASHI ARE LIVING AT THE SAME RELATIVE TIME GROWING UP IN DIFFERENT UNIVERSES (ASSUMING TIME REMAINS CONSTANT T1 = T2), WE CAN RE-EXAMINE THEIR PAST AND SAY THAT UP UNTIL THE POINT OF THE PHANTOMS THEIR SPACE AND TIME COORDINATES WERE THE SAME (X1, Y1, Z1, T1) = (X2, Y2, Z2, T2) IS TRUE, BUT THAT THEIR UNIVERSES WERE NOT THE SAME SO N1 $\neq$ N2.

THIS WOULD ALLOW THERE TO BE AN INFINITE NUMBER OF UNIVERSES IN WHICH EACH DECISION MADE BY A MASASHI WOULD SPAWN A NEW UNIVERSE. THIS HAS MANY OTHER IMPLICATIONS SUCH AS WHETHER THERE IS SUCH A THING AS FREE WILL OR WHETHER THE FRENCH PHILOSPHER, DECARTES, WAS CORRECT IN HIS SUGGESTION OF HUMAN AUTOMATON THEORY: THERE IS BUT ONE PERSON WITH CONSCIOUSNESS WHO CREATES THE WORLD AROUND HER OR HIM AND ALL OTHERS ARE SIMPLY FOLLOWING WHAT ONE IMAGINES. IF THIS WERE IN FACT THE CASE, PERHAPS WE COULD ADD A 6TH DIMENSIONS IN WHICH EACH PERSON HAS THEIR OWN CONCIOUSNESS THAT DETERMINES ALL OTHER SPACE-TIME / UNIVERSE COORDINATES, BUT I DIGRESS SINCE THE PURPOSE OF WRITING THIS WAS NOT PONDER PHILOSOPHY BUT TO ATTEMPT TO DEVELOP A BETTER UNDERSTANDING OF SPACETIME AND WORLD LINES.

TRANSLATION NOTES

DARK MATTER

DARK MATTER IS APTLY NAMED BECAUSE ELETROMAGNETIC RADIATION (MEDIATED BY PHOTONS), WHICH ALLOW US TO SEE, DOES NOT INTERACT WITH THIS FORM OF MATTER. THEREFORE, WE CANNOT SEE DARK MATTER AND IT IS "DARK" TO US AS HUMAN BEINGS. IT IS ESTIMATED THAT NEARLY 26.8% OF THE UNIVERSES MASS/ENERGY IS DARK MATTER COMPARED TO THE 4.9% THAT WE SEE ON A DAILY BASIS.

THOUGH WE HAVE NEVER DIRECTLY WITNESS DARK MATTER, WE CAN INFER ITS EXISTENCE FROM GRAVITATIONAL EFFECTS SUCH AS GRAVITATIONAL LENSING (WHERE AN OBJECT OF SUCH GREAT MASS DISTORTS THE LIGHT FROM ANOTHER OBJECT). BECAUSE WE HAVE NEVER BEEN ABLE TO DIRECTLY OBSERVE DARK MATTER, ITS CONSTITUENT PARTICLES ARE YET UNKNOWN. THOUGHT NOT NECESSARY, IT IS MATHEMATICALLY BELIEVED THAT DARK MATTER IS COMPRISED OF NON-BARYONIC MATTER SUCH AS AXIONS OR WIMPS (WEAKLY INTERACTING MASSIVE PARTICLES). THOUGH WIMPS ARE CURRENTLY THE MOST WIDELY ACCEPTED PARTICLE FOR THE LIKELINESS OF CONSTITUTING DARK MATTER, AXIONS HAVE RECENTLY REGAINED POPULARITY AMONG SOME PHYSICISTS AS THE INDIRECT OBSERVATION OF BLACK HOLES HAS HINTED THAT THEIR SINGULARITY MIGHT BE COMPRISED (OR AT LEAST PARTLY COMPRISED) OF AXIONS, WHOSE TRUE NATURE WOULD BE CLOAKED BY THE EVENT HORIZON (MORE ON THIS LATER).

EXOTIC MATTER IS A COLLOQUIAL TERM FOR ANY TYPE OF NON-BARYONIC MATTER, AND ASSUMING THAT DARK MATTER IS COMPRISED OF WIMPS AND NOT BARYONS, DARK MATTER WOULD BE A FORM OF EXOTIC MATTER. THOUGH NOT SEMANTICALLY IMPORTANT, NON-BARYONIC MATTER HAS BEEN PROPOSED (AT LEAST MATHEMATICALLY) TO BE ABLE TO PROPEL OBJECTS TO FASTER THAN LIGHT SPEEDS, ALLOW TIME TRAVEL, OR TO PREVENT WORM HOLES FROM COLLAPSING. THIS IS PARTICULARLY SIGNIFICANT SINCE NEARLY EVERY ONE OF THESE PROPOSALS SUGGESTS THE POSSBILITY OF TIME TRAVEL, GIVEN THE ABILITY TO HARNESS THE POWER OR EXOTIC MATTER.

DARK ENERGY

DARK ENERGY IS THE OTHER MASSIVE COMPONENT OF UNIVERSE. COMPARED TO REGULAR MATTER AND DARK MATTER, DARK ENERGY COMPRISES 68.3% OF THE THE ENTIRE UNIVERSES MASS. DESPITE SHARING THE MONIKER OF "DARK," DARK ENERGY IS NOT DIRECTLY RELATED TO DARK MATTER. THIS IS OFTEN CONFUSING AS MANY PEOPLE ASSUME THAT E=MC^2 APPLIED TO DARK MATTER WOULD LIBERATE DARK ENERGY, IN THE SAME WAY THAT E=MC^2 APPLIED TO REGULAR MATTER PRODUCES REGULAR ENERGY. HOWEVER, THIS IS NOT THE CASE. DARK ENERGY IS MOST OFTEN KNOWN FOR ITS PROPOSED (AND THEORETICAL) ROLE IN DRIVING THE EXPANSION OF THE UNIVERSE AS DEFINED BY THE COSMOLOGICAL CONSTANT.

TRANSLATION NOTES

DARK ENERGY (CONT'D)

LIKE DARK MATTER, DARK ENERGY HAS ONLY BEEN INDIRECTLY OBSERVED THROUGH OBSERVATION OF SUPERNOVAE, COSMIC MICROWAVE BACKGROUND, ETC. BECAUSE EVIDENCE IS ONLY INDIRECT, THERE ARE MANY COMPETING THEORIES THAT AIM TO EXPLAIN THE UNIVERSE WITHOUT DARK ENERGY. HOWEVER, DARK ENERGY IS STILL THE PREVAILING THEORY FOR WHY THE UNIVERSE'S EXPANSION IS ACCELERATING.

BLACK HOLES, SCHWARTZCHILD RADII, AND EVENT HORIZONS

MASASHI HAD PREVIOUSLY PROPOSED THAT PHANTOMS ARE BLACK HOLES. A BLACK HOLE IS AN OBJECT IN PHYSICS THAT IS SO MASSIVE (ACTUALLY REFERING TO MASS AND NOT SIZE) THAT THE GRAVITY IT GENERATES IS CAPABLE OF CURVING SPACETIME TO A DEGREE THAT LIGHT CANNOT ESCAPE; THUS, THE NAME BLACK (UNABLE TO SEE) HOLE. HOWEVER, THIS INABILITY TO ESCAPE OCCURS ONLY AFTER COMING WITHIN A CERTAIN DISTANCE TO THE BLACK HOLE. THIS DISTANCE IS REFFERED TO AS THE EVENT HORIZON. THE EVENT HORIZON IS "THE POINT OF NO RETURN" ONCE AN OBJECT, WHETHER IT BE LIGHT OR A PERSON, MOVES BEYOND THIS POINT, THEY WILL BE UNABLE TO ESCAPE THE GRAVITATIONAL PULL OF THE BLACK HOLE AND WILL DESCEND TOWARD THE BLACK HOLE'S CENTER.

IT IS IMPORTANT TO NOTE THAT UNTIL THE EVENT HORIZON IS REACHED THERE IS NO DIFFERENCE IN GRAVITY BETWEEN A BLACK HOLE AND ANY OBJECT THAT POSSESSES THE SAME MASS AS THAT BLACK HOLE. IN OTHER WORDS, OBJECTS CAN ORBIT A BLACK HOLE LIKE A PLANET ORBITS A STAR OR A MOON ORBITS A PLANET. TO UNDERSTAND WHY A BLACK HOLE ACTS MOSTLY THE SAME, WE MUST UNDERSTAND THE CONCEPT OF THE EVENT HORIZON AND ITS SIZE. THE SCHWARTZCHILD RADIUS IS THE POINT BEYOND WHICH IF THE MASS OF AN OBJECT IS COMPRESSED, THE OBJECT WILL BECOME A BLACK HOLE. ONCE AN OBJECT'S MASS IS COMPRESSED BEYOND THE SCHWARTZCHILD RADIUS, THE THE SCHWARTZCHILD RADIUS OF A BLACK HOLE BECOMES (FOR ALL INTENTS AND PURPOSES) THE EVENT HORIZON.

TO GIVE AN EXAMPLE OF THE SIZE OF AN EVENT HORIZON, LET'S ASSUME THAT THE EARTH'S SUN COLLAPSED INTO A BLACK HOLE (NOTE THAT IT CAN'T BECAUSE IT DOES NOT HAVE THE NECESSARY MASS, AND THEREFORE, DOES NOT HAVE THE NECESSARY GRAVITY TO OVERCOME NEUTRON AND ELECTRON DEGENERACY PRESSURE WHICH RESISTS THE COLLAPSE OF MATTER BY PUSHING OUT AGAINST THE MATTER TRYING TO COLLAPSE IN). HOWEVER, ASSUMING THAT IT COULD BECOME A BLACK HOLE, THE SUN HAS A RADIUS (FROM CENTER TO OUTSIDE) OF 695,700 KM (432,288 MILES). BY COMPARISON, THE EARTH HAS A RADIUS OF 6,371 KM (3,959 MILES). IF THE SUN WERE ABLE TO BECOME A BLACK HOLE, IT WOULD NEED TO BE COMPRESSED BELOW ITS SCHWARTZCHILD RADIUS, WHICH IS JUST 3 KM (~1.8 MILES)! THAT IS INCREDIBLY SMALL. MOST LONG DISTANCE RUNNERS COULD RUN THIS IN FEWER THAN 16 MINUTES.

TRANSLATION NOTES

BLACK HOLES, SCHWARTZCHILD RADII, AND EVENT HORIZONS (CONT'D)

THIS MEANS THAT IF OUR SUN COLLAPSED RIGHT NOW, WE WOULDN'T NOTICE FOR EIGHT MINUTES. AFTER EIGHT MINUTES THE LIGHT WOULD GO OUT, OUR PLANET WOULD COOL TO INHOSPITABLE TEMPERATURES, AND WE'D LIKELY ALL DIE. HOWEVER, OUR PLANET WOULD CONTINUE REVOLVING AROUND THE THE BLACK HOLE JUST AS IF IT WERE THE SUN; JUST AS IT ALWAYS HAS.

ASSUMING THAT EARTH EVER REACHED THE POINT WHERE IT WAS 3 KM FROM THIS BLACK HOLE, THE EARTH WOULD BE "SUCKED" INTO IT. MORE LIKELY PARTS OF THE EARTH WOULD BE SHEARED OFF BY TIDAL FORCES EXERTED BY THE BLACK HOLE, BUT REGARDLESS, THIS WOULD TAKE MILLIONS TO BILLIONS OF YEARS SINCE THE EARTH IS IN A FAIRLY STABLE ELLIPTICAL ORBIT.

JUST FOR THE FUN OF IT, LET'S ASSUME THAT THE EARTH BECAME A BLACK HOLE, HOW LARGE WOULD IT'S SCHWARTZCHILD RADIUS BE? WELL, YOU MIGHT BE SHOCKED, BUT IT WOULD BE ABOUT 9 MILLIMETERS. THAT IS NOT EVEN A CENTIMETER! THIS MEANS THAT THE PHANTOMS THAT FUTURE MASASHI HAS SENT BACK IN TIME HAVE A SCHWARTZCHILD RADIUS LARGER THAN THAT OF THE EARTH, BUT LESS THAN THAT OF OUR SUN.

ASSUMING THAT EACH PHANTOM HAS A SCHWARTZCHILD RADIUS OF ABOUT A METER (2 METERS IN DIAMETER), EACH PHANTOM WOULD HAVE HAD TO HAVE A MASS OF ABOUT $1.34x10^{27}$ KILOGRAMS, WHICH IS AN INCREDIBLE AMOUNT OF MASS (THE EARTH IS ONLY $5.97x10^{24}$ KILOGRAMS, MEANING EACH PHANTOM HAS MASS A LITTLE OVER 4,400,000 TIMES MORE THAN THE EARTH). THEN AGAIN, IF MASASHI WAS ABLE TO TAP INTO THE MASS OF MULTIPLE UNIVERSES, THEY WOULDN'T NEED TO GATHER THAT MASS THEMSELVES. THEY COULD SIMPLY OPEN A SPACETIME WORMHOLE AT THE SAME LOCATION ACROSS MILLIONS OF UNIVERSES AND LET THE MATTER COMPRESS TO A BLACKHOLE. HOWEVER, I'M JUST EXTRAPOLATING AT THIS POINT AND NOWHERE IN THE STORY DID THE AUTHOR MENTION THIS. IT'S JUST KIND OF FUN TO THINK ABOUT HOW IT MIGHT HAVE BEEN DONE.